S/N 5919

XANTREX
TRANSFORMING DC POWER

Technical Manual

LX Series Power Supplies

This manual covers models:

LX 20-3
LX 30-2
LX 60-1
LX 20-6
LX 30-4
LX 60-2
LXQ 20-3
LXQ 30-2
LXQ 60-1

Xantrex LX Series Laboratory Power Supply

TECHNICAL MANUAL

Release 3.2 (12/91)

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1584 Fell Avenue
North Vancouver, B.C.
V7P 3E7

Tel.: (604) 984-4268
FAX: (604) 984-9758

Customer Service: 1-800-667-8422

Warranty

This Xantrex product is warranted for three (3) years from the date of delivery against defects in material and workmanship. The manufacturer will repair or replace the non-conforming product or issue credit, at its option, provided the manufacturer's inspection establishes the existence of a defect. Packing, freight, insurance, and other charges incurred in returning the defective products to the manufacturer will be paid by the purchaser.

Limitation of Warranty

This warranty does not apply to products damaged through accident, abuse, misuse, or unauthorized repair. Xantrex shall not be liable for any special or consequential damage of any nature.

If any questions arise concerning the warranty, contact Xantrex prior to taking any action.

Model and Serial Number

When requesting information, assistance, or authorization, please state the model and serial number of the unit, available from the rear of the unit.

Model Number LXQ 60-1

Serial Number 5919

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1. LX SERIES FEATURES AND SPECIFICATIONS

1.1 Description

The LX Series supplies are linear power supplies with either dual or quad outputs. Dual models are 60 Watt or 120 Watt units with one adjustable and one fixed output. Quad models are 60 Watt units with two adjustable and two fixed outputs. The series consists of nine models with output voltage and current combinations as shown.

	Output #1		Output #2		Output #3		Output #4	
Model #	**Voltage**	**Current**	**Voltage**	**Current**	**Voltage**	**Current**	**Voltage**	**Current**
60W Dual								
LX20-3	0-20V	0-3A	+5V	3A Max				
LX30-2	0-30V	0-2A	+5V	3A Max				
LX60-1	0-60V	0-1A	+5V	3A Max				
120W Dual								
LX20-6	0-20V	0-6A	+5V	3A Max				
LX30-4	0-30V	0-4A	+5V	3A Max				
LX60-2	0-60V	0-2A	+5V	3A Max				
60W Quad								
LXQ20-3	0-20V	0-3A	0-20V	0-3A	+5V	3A Max	+5V	3A Max
LXQ30-2	0-30V	0-2A	0-30V	0-2A	+5V	3A Max	+5V	3A Max
LXQ60-1	0-60V	0-1A	0-60V	0-1A	+5V	3A Max	+5V	3A Max

1.2 Features

The LX Series provides high quality yet economical DC power for education, design, and service applications.

- Constant Voltage or Constant Current operation with automatic mode crossover
- Excellent output regulation
- Low output noise and ripple
- Simultaneous digital displays for output voltage and current
- Front panel LEDS for voltage mode, current mode, and fixed +5V output overload
- Isolated outputs allow series or parallel connection
- All outputs short circuit protected
- Switch-selectable tracking on quad units

1.3 Electrical Specifications

AC Input Voltage	115Vac ± 10% @ 47-63Hz
AC Input Current	1.5A (60W Dual) 4.0A (120W Dual, 60W Quad)
Operating Ambient Temperature	0°C to 30°C for full rated output Derate linearly to zero at 70°C
Storage Temperature	-55°C to +85°C
Maximum Voltage Differential	500Vdc from output to safety ground
Fixed Output Range	+5V ±4% 0-3A minimum

Variable Output Specifications	**Voltage Mode**	**Current Mode**
Line Regulation	0.02% + 2mV	0.05% + 250μA
Load Regulation	0.02% + 2mV	0.05% + 250μA
Noise and Ripple	0.5mVrms/4mVp-p	2mArms/10mAp-p
Tracking Accuracy (Quad Unit)	Adjustable to within ±(0.02% + 5mV)	

1.4 Mechanical Specifications

UNIT	HEIGHT	WIDTH	DEPTH	WEIGHT
60W Dual Unit	127mm/ 5.2in	108mm/ 4.25in	280mm/ 11.0in	4.3kg/ 9.4lb
60W Quad Unit or 120W Dual Unit	127mm/ 5.2in	216mm/ 8.5in	280mm/ 11.0in	7.1kg/ 15.6lb

Input Connector	AC line cord with safety ground, 125V/15A rated
Output Connectors	Binding posts, 3/4" between centers

SECTION 2. INSTALLATION

2.1 Introduction

This section contains procedures for inspecting, installing, and testing the LX Series supply.

2.2 Safety

Exercise caution when using and servicing power supplies. Potentially destructive energy levels can be stored at the output voltage terminals on all power supplies in normal operation. In addition, any single model or series configuration which results in output of 40V or greater represents a potential personal hazard.

Use extra caution when biasing the output relative to the chassis due to potential high voltage levels at the output terminals.

2.3 Initial Inspection

After unpacking, perform an initial inspection to ensure the unit has not been damaged in transit.

- Inspect for mechanical damage such as dents and scratches to the front panel, cover, and chassis; and for any broken controls, connectors, or displays.
- Turn front panel controls from stop to stop. Rotation should be smooth.
- Test the action of the power switch.
- If you suspect internal damage, remove the cover and check for printed circuit board and/or component damage. Reinstall cover.

If damage has occurred, save all packing materials and notify the carrier immediately. Direct any repair problems to:

Xantrex Technology Inc.
1584 Fell Avenue
North Vancouver, B.C.
V7P 3E7

Customer Service Inquiries: 1-800-667-8422
Telephone: (604) 984-4268
FAX: (604) 984-9758

2.4 Location and Ventilation

The LX Series supply is convection-cooled. When locating the supply, ensure that the ventilation holes on the bottom and the top of the unit are not obstructed.

2.5 AC Input Power

The supply requires a grounded 115Vac ±10%, 47-63Hz input.

CAUTION: A potential shock hazard will exist if the supply is connected to an ungrounded outlet.

2.6 Initial Functional Tests

These basic functional tests ensure that the unit is in working order after shipping. These tests may also be used to verify basic operation when the unit has been withdrawn from storage, or when the unit has been transferred from another application.

Variable Output Voltage Mode Operation Check

- Ensure that the AC power switch is in the OFF position.
- Connect the unit to a 115Vac 60Hz outlet.
- Turn the voltage and current controls fully counter-clockwise.
- Ensure the tracking switch on a quad unit is in the independent position.
- Connect a Digital Voltmeter (DVM) to the output terminals, observing correct polarity. The DVM must be rated better than 0.5% accuracy.
- Turn the front panel AC power switch ON.

The front panel digital meters will light up and voltmeter and ammeter displays will read zero.

- Turn the CURRENT control a 1/2-turn clockwise. Slowly turn the VOLTAGE control clockwise and observe both the front panel voltmeter and the DVM.
- Compare the DVM reading with the front panel voltmeter reading to verify the accuracy of the internal voltmeter.

The minimum control range will be from zero to the maximum rated output for this particular power supply model. The green voltage mode LED will be illuminated.

Variable Output Current Mode Operation Check

- Ensure that the AC power switch is in the OFF position.
- Connect the unit to a 115Vac 60Hz outlet.
- Turn the voltage and current controls fully counter-clockwise.
- Ensure the tracking switch on a quad unit is in the independent position.
- Connect a DC ammeter or a shunt-Digital Voltmeter (DVM) combination across the output terminals, using appropriately-gauged wire and hardware. The recommended current ratings for the ammeter or the shunt and the wire must be at least 10% more than the output current of the power supply model. The ammeter or shunt-DVM combination must be rated better than 0.5% accuracy.
- Turn the AC power switch ON.

The front panel digital meters will light up and voltmeter and ammeter displays will read zero.

- Turn the VOLTAGE control one (1) or two (2) turns clockwise.
- Turn the CURRENT control slowly clockwise.
- Compare the ammeter reading with the front panel ammeter reading. Or, compare the DVM reading with the front panel ammeter reading using I=V/R where V is the DVM reading and R is the DC shunt resistance.

The control range will be from zero to the maximum rated output for the power supply model. The red current mode LED will be illuminated.

Fixed 5V Output Voltage Check

- Ensure that the AC power switch is in the OFF position.
- Connect the unit to a 115Vac 60Hz outlet.
- Connect a voltmeter across the fixed output binding posts, observing correct polarity.
- Turn the AC power switch ON.
- Check for a reading of 5V±4%.

Fixed 5V Output Current Check

If you should have occasion to check the output current for the fixed output, the test procedure requires that you connect a variable load.

- Ensure that the AC power switch is in the OFF position.
- Connect the unit to a 115Vac 60Hz outlet.
- Connect an ammeter and a variable load to the fixed output binding posts, observing correct polarity.
- Turn the AC power switch ON.
- Vary the load and check for an output range of 0-3A.

SECTION 3. LOAD CONNECTION

3.1 Introduction

This section provides recommendations for load wiring and connecting.

3.2 Load Wiring

When connecting load wiring to the power supply, you must consider the following factors:

- the current carrying capacity of the wire, and
- the noise and impedance effects of the load lines.

Current Carrying Capacity

As a minimum, load wiring must have a current capacity greater than the output current rating of the power supply. This ensures that the wiring will not be damaged even if the load is shorted. The table below shows the maximum current rating, based on 450 amps per square centimeter, for various gauges of wire rated for 105 degrees C operation. Operation at the maximum current rating results in approximately a 30 degree temperature rise for a wire operating in free air. Where load wiring must operate in areas with elevated ambient temperatures or bundled with other wiring, larger gauges or higher temperature-rated wiring should be used.

AWG	Maximum Current
14	10.2
16	6.4
18	4.1
20	2.5
22	1.6
24	1.0
26	0.32

Noise and Impedance Effects

To minimize noise pickup or radiation, load wires should be shielded-twisted pair of as short a length as possible. Connect the shield wire to the front panel chassis ground binding post. Where shielding is impossible or impractical, simply twisting the wires together will offer some noise immunity.

3.3 Making the Connections

Load connections to the power supply are made at the front panel positive and negative output binding posts. When making connections to the binding posts, ensure that load wiring is placed to avoid touching the other post and shorting the power supply output.

3.4 Connecting Multiple Loads

Proper connection of distributed loads is an important aspect of power supply applications. Two common methods of connection are the parallel power distribution method and the radial distribution method.

Parallel Power Distribution

This method involves connecting leads from the power supply to one load, from that load to the next load, and so on for each load in the system. This distribution method results in the voltage at each load depending on the current drawn by the other loads and allows dc ground loops to develop. Except for low current applications, this method is not recommended.

Radial Distribution Method

With this method, power is connected to each load individually from a single pair of terminals designated as the positive and negative distribution terminals. These terminals may be the power supply output binding posts, the terminals of one of the loads, or a distinct set of terminals especially established for distribution use.

Figures 3.4-1 shows recommended load connections for multiple loads.

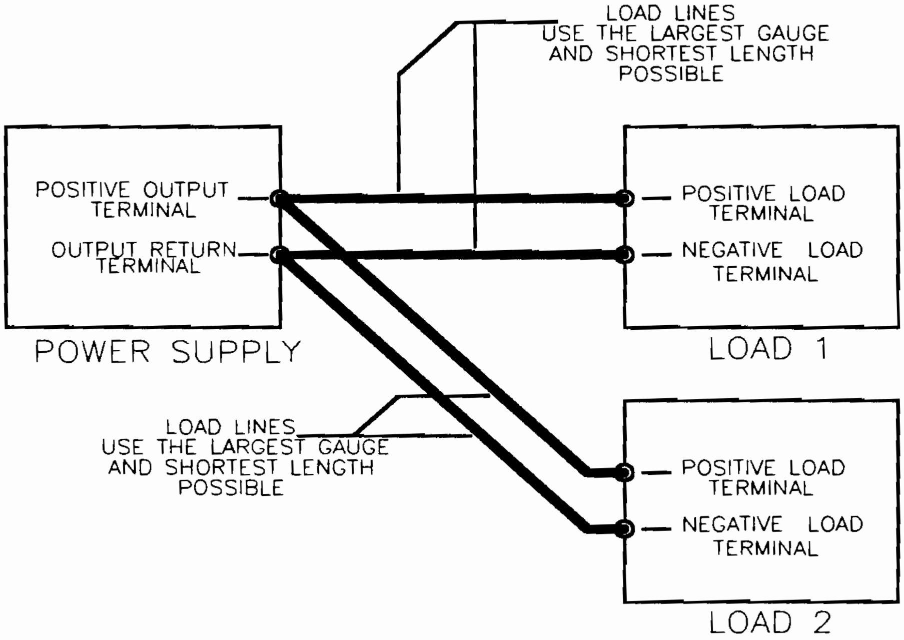

Figure 3.4-1 Multiple Loads

SECTION 4. OPERATING INSTRUCTIONS

4.1 Introduction

The LX Series consists of two basic types:

- Dual output units (60W or 120W) with one variable and one fixed output
- Quad output units (60W) with two variable and two fixed outputs

4.2 Variable Output Operation

The variable outputs can be operated in either constant voltage mode or constant current mode with automatic crossover between modes in response to changing load requirements. See **Section 4.6** for more detailed information about constant voltage and constant current modes.

Digital meters display the output voltage and current. Mode LEDS indicate the operating mode of the supply.

Voltage Mode Operation

To operate the supply in voltage mode:

- Set the current limit control fully clockwise.
- Adjust the voltage control to the desired output.

The supply will maintain the output voltage at the desired level while the current will vary with changes in the load. The supply will remain in voltage mode operation until the current exceeds the current limit setting, at which point the supply will automatically switch to current mode operation.

Current Mode Operation

To operate the supply in current mode:

- Disconnect any load.
- Set the voltage control fully clockwise (or to the compliance voltage of the circuit).
- Turn the current limit control fully counter-clockwise.
- Short the output terminals of the supply with a suitable jumper wire.
- Adjust the current limit to the desired level.
- Turn off the supply.
- Remove the jumper wire.
- Reconnect the load.
- Turn the supply on.

The supply maintains the output current at the selected value while the output voltage varies with the load requirements. The supply will remain in current mode operation until the load current requirement becomes less than the current limit setting, at which point the supply will automatically switch to voltage mode operation.

4.3 Fixed Output Operation

The overload (OL) LED is illuminated whenever an output current overload causes the output voltage to drop to between 4.7V and 1.6V.

4.4 Series and Parallel Operation

All outputs are fully isolated from the AC input and one another. They may be connected in series or in parallel provided that the outputs are connected to source current from the positive terminals and no output point exceeds safety ground by more than 500Vdc.

Series Operation

Series operation is used to obtain a higher voltage from a single output using two or more supplies or outputs. Connect the negative (-) output terminal of one supply to the positive (+) output terminal of the next supply. The total voltage available is the sum of the maximum voltages of each supply (add voltmeter readings). The maximum allowable current for a series string is the lowest output current rating of any output in the string.

Parallel Operation (Variable Operation Only)

Parallel operation is used to obtain a higher current through a single output using two or more supplies or outputs of a single supply. Set all of the outputs to the same voltage before connecting the positive (+) output terminals and the negative (-) output terminals in parallel. The total current available is the sum of the maximum currents of each supply/output.

Note: When operating multiple supplies in parallel, the operating mode of each supply will depend on the load current being drawn. For example, with two LX20-3 power supplies operating in parallel with a 5A load, one supply will operate in constant current mode supplying 3A and the other supply will operate in voltage mode supplying the remaining 2A.

4.5 Tracking Feature in Quad Units

The variable output sections of quad units can be operated as a master/slave combination in which the slave output voltage will track that of the master. To use this feature:

- Set the front panel Independent/Tracking switch to the Tracking position.
- Adjust the master voltage control to the desired output.
- Adjust the slave voltage control so that the slave output voltage is the same as the master.

The master voltage control will now control both outputs at the same voltage as long as both units are operating in voltage mode.

Notes:

1. Both the master and slave current limits can be set independently. If the slave goes into current limiting mode, the master will continue unaffected. If the master goes into current limiting mode, the slave output voltage will vary with the master.
2. When the Independent/Tracking switch is returned to the Independent position, the slave output will go to near the maximum rated output voltage of the supply.
3. The load regulation of the slave output is degraded when operating in tracking mode.

4.6 Operating Modes and Automatic Crossover

The LX Series power supply has two basic operating modes: Constant Voltage Mode and Constant Current Mode. The mode in which the power supply operates at any given time depends on the combination of:

- the output voltage setting V_{SET} ,
- the output current limit setting I_{SET} , and
- the resistance of the attached load R_L .

Figure 4.6-1 Operating Modes provides a graphical representation of the relationships between these variables.

Constant Voltage Mode Operation

The power supply will operate in constant voltage mode whenever the load current I_L **is less than** the current limit setting I_{SET} , or: $I_L < I_{SET}$ (Note: $I_L = V_{SET} / R_L$)

In constant voltage mode, the power supply maintains the output voltage at the selected value (V_{SET}) while the load current I_L varies with the load requirements.

Constant Current Mode Operation

The power supply will operate in constant current mode whenever the load resistance is low enough that the load current I_L **is greater than** the current limit setting I_{SET} , or: $I_L > I_{SET}$

In constant current mode, the power supply maintains the output current at the selected value (I_{SET}) while the load voltage varies with the load requirements.

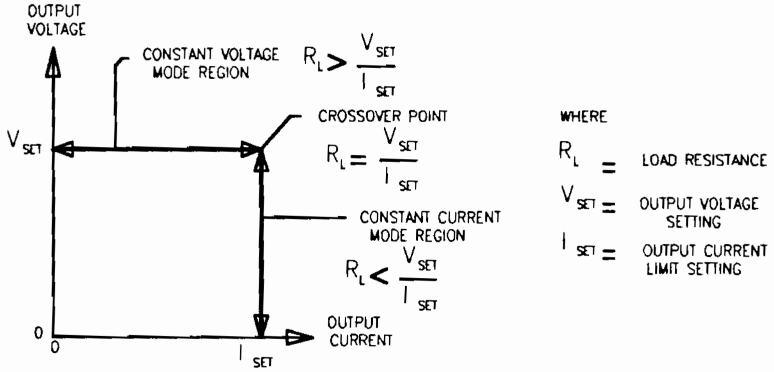
OUTPUT VOLTAGE
CONSTANT VOLTAGE MODE REGION
$R_L > \frac{V_{SET}}{I_{SET}}$
CROSSOVER POINT
$R_L = \frac{V_{SET}}{I_{SET}}$
V_{SET}
CONSTANT CURRENT MODE REGION
$R_L < \frac{V_{SET}}{I_{SET}}$
0
0
I_{SET}
OUTPUT CURRENT
WHERE
R_L = LOAD RESISTANCE
V_{SET} = OUTPUT VOLTAGE SETTING
I_{SET} = OUTPUT CURRENT LIMIT SETTING

Figure 4.6-1 Operating Modes

Automatic Mode Crossover

This feature allows the power supply to automatically switch operating modes in response to changing load requirements. If, for instance, the power supply was operating in Constant Voltage Mode ($I_L < I_{SET}$), and the load changed so that the load current (I_L) became **greater than** the current limit setting (I_{SET}), the power supply would automatically switch into Constant Current Mode. If the additional load was subsequently removed so that the load current was again **less than** the current limit setting, the supply would automatically return to Constant Voltage Mode.

SECTION 5. MAINTENANCE AND REPAIRS

5.1 Introduction

This section provides maintenance information and replacement parts lists for the LX Series supplies.

5.2 Units Under Warranty

Units requiring repair during their warranty period should be returned to Xantrex Technology Inc. for service. Unauthorized repairs performed by any one other than Xantrex during the warranty period may void the warranty. Any questions regarding the warranty or any repairs should be directed to:

Xantrex Technology Inc.
1584 Fell Avenue
North Vancouver, B.C.
V7P 3E7

Customer Inquiries (toll free): 1-800-667-8422
Telephone: (604) 984-4268
FAX: (604) 984-9758

5.3 Periodic Service

No routine servicing of the LX Series supply is required except for periodic cleaning. Whenever a unit is removed from operation, it should be cleaned with naphtha or an equivalent solvent for the metal surfaces and with a weak solution of soap and water for the front panel. A vacuum or low pressure compressed air may be used to remove dust from in and around components on the printed circuit boards.

5.4 Unusual or Erratic Operation

If the power supply displays any unusual or erratic operation, follow these steps:

- Shut the power supply off immediately.
- Disconnect it from the AC power source.
- Disconnect any load(s).
- Check the AC input for correct voltage and frequency.
- Reconnect the AC input and test the power supply according to the procedures in **Section 2.6 Initial Functional Tests.**

If the supply has operated correctly during function testing:

- Check the load for faults.
- Correct any problems found.
- Reconnect the load to the power supply.
- Retest the system. (See **Section 2.6 Initial Functional Tests.**)

If the problem has not been solved after following this procedure, call Xantrex Technology's service department for assistance.

5.5 Servicing Precautions

Always disconnect power and discharge circuits before replacing components. Repairs must be made by experienced technical personnel only.

Use proper static control techniques to avoid damage to front panel display drivers and other static-sensitive parts.

Be sure to isolate the power supply from the input line with an isolation transformer when using grounded test equipment, such as an oscilloscope, in the primary circuit.

5.6 Replacement Parts

This section provides replacement parts lists for the LX Series of power supplies. Do not use substitute parts without first checking with Xantrex Technology's service department regarding their compatibility.

Note: **When ordering replacement parts, please include the power supply model number and serial number in addition to the part number and description.**

Parts lists for the LX Series are divided into the following assemblies:

- Front Panel (A1) Assembly
- Power Transformer
- Power Circuit (A2) Assembly
- AC Input and Miscellaneous Parts

Most assemblies consist of parts common to all LX Series models as well as parts which are model-specific, or differential.

Front Panel (A1) Assembly

The parts list for the Front Panel Assembly is divided into:

1) Complete Front Panel Assembly (includes 2), 3), and 4), below)
2) Sheet Metal and Label Assemblies
3) Front Panel Hardware
4) A1 PCB Assembly

1) Complete Front Panel Assembly

Designation	Description	Part #
Model LX 20-3	Complete Front Panel	X2-LXFP-203D
Model LX 30-2	Complete Front Panel	X2-LXFP-302D
Model LX 60-1	Complete Front Panel	X2-LXFP-601D
Model LX 20-6	Complete Front Panel	X2-LXFP-2061
Model LX 30-4	Complete Front Panel	X2-LXFP-3041
Model LX 60-2	Complete Front Panel	X2-LXFP-6021
Model LXQ 20-3	Complete Front Panel	X2-LXFP-203Q
Model LXQ 30-2	Complete Front Panel	X2-LXFP-302Q
Model LXQ 60-1	Complete Front Panel	X2-LXFP-601Q

2) Front Panel Sheet Metal and Label Assembly

Designation	Description	Part #
Model LX 20-3	Front Panel Label Only	LA-LXFP-203D
Model LX 30-2	Front Panel Label Only	LA-LXFP-302D
Model LX 60-1	Front Panel Label Only	LA-LXFP-601D
Model LX 20-6	Front Panel Label Only	LA-LXFP-2061
Model LX 30-4	Front Panel Label Only	LA-LXFP-3041
Model LX 60-2	Front Panel Label Only	LA-LXFP-6021
Model LXQ 20-3	Front Panel Label Only	LA-LXFP-203Q
Model LXQ 30-2	Front Panel Label Only	LA-LXFP-302Q
Model LXQ 60-1	Front Panel Label Only	LA-LXFP-601Q
Model LX 20-3	F/P Sheet Metal and Label	X2-FPLF-203D
Model LX 30-2	F/P Sheet Metal and Label	X2-FPLF-302D
Model LX 60-1	F/P Sheet Metal and Label	X2-FPLF-601D
Model LX 20-6	F/P Sheet Metal and Label	X2-FPLF-2061
Model LX 30-4	F/P Sheet Metal and Label	X2-FPLF-3041
Model LX 60-2	F/P Sheet Metal and Label	X2-FPLF-6021
Model LXQ 20-3	F/P Sheet Metal and Label	X2-FPLF-203Q
Model LXQ 30-2	F/P Sheet Metal and Label	X2-FPLF-302Q
Model LXQ 60-1	F/P Sheet Metal and Label	X2-FPLF-601Q

3) Front Panel Hardware

Designation	Description	Part #
	Binding Post, Black, #6-32	MC-BP21-B
	Binding Post, Red, #6-32	MC-BP21-R
	Binding Post, Green, #6-32	MC-BP21-GN
	Black Knob	MK-4094-SB
	#6-32 x 3/8" PPM Zinc Screw	MS-6P00-06
	#6-32 x 1/4" x 3/16" Threaded Brass Spacer	MR-625T-03B

4) Front Panel A1 PCB Assembly

The parts list for the Front Panel A1 PCB Assembly is divided into:

- i) Complete A1 PCB Assembly (includes ii) and iii), below)
- ii) A1 PCB Common Parts
- iii) A1 PCB Differential Parts

i) Complete A1 PCB Assembly

Designation	Description	Part #
Model LX 20-3	A1 PCB Assembly	X2-LXA1-203D
Model LX 30-2	A1 PCB Assembly	X2-LXA1-302D
Model LX 60-1	A1 PCB Assembly	X2-LXA1-601D
Model LX 20-6	A1 PCB Assembly	X2-LXA1-2061
Model LX 30-4	A1 PCB Assembly	X2-LXA1-3041
Model LX 60-2	A1 PCB Assembly	X2-LXA1-6021
Model LXQ 20-3	A1 PCB Assembly	X2-LXA1-203Q
Model LXQ 30-2	A1 PCB Assembly	X2-LXA1-302Q
Model LXQ 60-1	A1 PCB Assembly	X2-LXA1-601Q

ii) A1 PCB Assembly Common Parts

Circuit Designation	Description	Part #
C1,9,21	10μF 25V 20% 5mm Tantalum Capacitor	CJ-100F-25
C2,5,8,11,13,14, 19,20	0.33μF 50V Z5U -20% to +80% 5mm Cer Rad Cap	CC-334F-09
C3,15	47pF 100V X7R 10% 5mm Ceramic Radial Cap	CB-470F-16
C4,16,	0.1μF 50V X7R 10% 5mm Ceramic Radial Capacitor	CB-104F-06
C6,18	47nF 50V X7R 10% 5mm Ceramic Radial Capacitor	CB-473F-06
C7,17	0.1μF 250V MF 10% 10mm Radial Capacitor	CD-104J-26
C22	10μF 100V 3.5mm Electrolytic Radial Capacitor	CL-100E-76
CR1,2	Red LED, T-1 3/4 3mcd @10mA	DS-5103-R2
For CR1, 2, 7	0.25" x 0.2" Insulating Standoff	MR-625I-145
CR3	1N825A VZ D035 6.2V 400mW Zener Diode	CR-0825-A
CR4,5,6	1N4148 UR D035 75V 300mA Diode	CR-4148
CR7	Green LED, T-1 3/4 3mcd @10mA	DS-5173-G2
DS1,2,3	Orange 7-Segment Display	DS-1131-O7
DS4,5,6	Green 7-Segment Display	DS-0161-G7
For DS1-6, U1, U4	Molex IC Pin Socket (In Strip, for ICS)	MC-0001-IC
P1	9-pin Male 0.1" Friction Lock Pin Header	MC-0903-MC
Q1	PN2907A PB 60V .5mA 400mW TO92 Transistor	QN-2907-A
R1,5,9,23,24,36,38	1.00kΩ 1% 1/4W MF	R-1001-41
R2,16,39	Calibration Resistor	
For R2, 16, 39	Component Lead Socket, .025", .052 Mtng Hole	
R4	1MΩ 1% 1/4W MF	R-1004-41
R6,29,33	100k 1% 1/4W MF	R-1003-41
R7,14,31	357Ω 1% 1/4W MF	R-3570-41
R8,32	Resistor Empty Position	R-EMPT
R10	5k 1-turn 1/2W 20% Panel Mount 1/4" Shaft Pot.	RP-5001-18
R11,13,19,30	475k 1% 1/4W MF	R-4753-41
R15,25	4.02k 1% 1/4W MF	R-4021-41

Continued on next page.

ii) A1 PCB Assembly Common Parts (continued)

Circuit Designation	Description	Part #
R16	5.62k 1% 1/4W	R-5621-41
R18	475Ω 1% 1/4W MF	R-4750-41
R20	10k 1% 1/4W MF	R-1002-41
R26,35	82.5k 1% 1/4W MF	R-8252-41
R34	5k 10-turn 2W 5% Panel Mount 1/4" Shaft Pot.	RP-5001-0
R40	7.5Ω 1% 1/4W MF	R-7501-41
U1,4	7107 CMOS 3.5 Digit A/D LED Driver	UD-7107-C
For U1, U4	Molex IC Pin Socket (In Strip, for ICS)	MC-0001-IC
U2	MC34064P Power Reset IC TO92	US-3406-4P
U3	324 Quad Op Amp (Ground Sensing) 14-pin DIP	UA-0324-N
For U3	IC Socket DIL 14 pin	MC-0014-IC

iii) A1 PCB Assembly Differential Parts

These differential parts are divided into 20V, 30V, and 60V lists. On each list, certain circuits will require different parts, according to the actual supply model. Check your model number to confirm.

A1 PCB Assembly Differential Parts - All 20V Models

Circuit Designation	Model Number	Description	Part #
C10	All	100pF 100V Z5F 10% 2.5mm Cer Rad Cap	CB-101F-16
C12	All	22pF 100V NPO 5% 5mm Cer Rad Cap	CA-220F-15
P2	LX20-3 LXQ20-3	Empty Position	P-EMPT
P2	LX20-6	9-pin Male 0.1" Friction Lock	MC-0903-MC
R3	LX20-3 LXQ20-3	3.74k 1% 1/4W	R-3741-41
R3	LX20-6	17.8k 1% 1/4W	R-1782-41
R12	LX20-3 LXQ20-3	187Ω 1% 1/4W MF	R-1870-41
R12	LX20-6	47.5Ω 1% 1/4W MF	R-47R5-41
R21	LX20-3 LXQ20-3	649Ω 1% 1/4W	R-6490-41
R21	LX20-6	332Ω 1% 1/4W	R-3320-41
R22	LXQ20-3	13.3k 1% 1/4W MF	R-1332-41
R22	LX20-3 LX20-6	Empty Position	R-EMPT
R27	All	52.3kΩ 1% 1/4W MF	R-5232-41
R28	LX20-3 LXQ20-3	0.2Ω 5% 5W Wire Wound	RW-R200-5
R28A	LX20-3 LXQ20-3	Empty Position	R-EMPT
R28,28A	LX20-6	0.1Ω 1% 5W Wire Wound	RW-R100-51
R37	All	44.2k 1% 1/4W MF	R-4422-41
SW1	LX20-3 LX20-6	Empty Position	SW-EMPT
SW1	LXQ20-3	DPDT Toggle 6A 125Vac Term. ON-ON	SW-2237-TH1

A1 PCB Assembly Differential Parts - All 30V Models

Circuit Designation	Model Number	Description	Part #
C10	All	100pF 100V Z5F 10% 5mm Cer Rad Cap	CB-101F-16
C12	LX30-2 LXQ30-2	22pF 100V NPO 5% 5mm Cer Rad Cap	CA-220F-15
C12	LX30-4	100pF 100V Z5F 10% 5mm Cer Rad Cap	CB-101F-16
P2	LX30-2 LXQ30-2	Empty Position	P-EMPT
P2	LX30-4	9-pin Male 0.1" Friction Lock	MC-0903-MC
R3	LX30-2 LXQ30-2	3.74k 1% 1/4W	R-3741-41
R3	LX30-4	8.25k 1% 1/4W	R-8251-41
R12	LX30-2 LXQ30-2	187Ω 1% 1/4W MF	R-1870-41
R12	LX30-4	100Ω 1% 1/4W MF	R-1000-41
R21		432Ω 1% 1/4W	R-4320-41
R22	LXQ30-2	23.7k 1% 1/4W MF	R-2372-41
R22	LX30-2 LX30-4	Empty Position	R-EMPT
R27		61.9kΩ 1% 1/4W MF	R-6192-41
R28	LX30-2 LXQ30-2	0.2Ω 5% 5W Wire Wound	RW-R200-5
R28	LX30-4	0.1Ω 5% 5W Wire Wound	RW-R100-51
R28A		Empty Position	R-EMPT
R37		28k 1% 1/4W	R-2802-41
SW1	LX30-2 LX30-4	Empty Position	SW-EMPT
SW1	LXQ30-2	DPDT Toggle 6A 125Vac Term. ON-ON	SW-2237-TH1

A1 PCB Assembly Differential Parts - All 60V Models

Circuit Designation	Model Number	Description	Part #
C10	All	1nF 100V X7R 10% 5mm Cer Radial Cap	CB-102F-16
C12	All	100pF 100V Z5F 10% 5mm Cer Radial Cap	CB-101F-16
P2	LX60-1 LXQ60-1	Empty Position	P-EMPT
P2	LX60-2	9-pin Male 0.1" Friction Lock	MC-0903-MC
R3	All	3.74k 1% 1/4W	R-3741-41
R12	All	187Ω 1% 1/4W MF	R-1870-41
R21	LX60-1 LXQ60-1	232Ω 1% 1/4W	R-2320-41
R21	LX60-2	432Ω 1% 1/4W	R-4320-41
R22	LXQ60-1	47.5k 1% 1/4W	R-4752-41
R22	LX60-1 LX60-2	Empty Position	R-EMPT
R27	All	82.5k 1% 1/4W MF	R-8252-41
R28	All	0.2Ω 5% 5W Wire Wound	RW-R200-5
R28A	All	Empty Position	R-EMPT

Continued on next page.

A1 PCB Assembly Differential Parts - All 60V Models (continued)

Circuit Designation		Description	Part #
R37	All	15k 1% 1/4W MF	R-1502-41
SW1	LX60-1 LX60-2	Empty Position	SW-EMPT
SW1	LXQ60-1	DPDT Toggle 6A 125Vac Term. ON-ON	SW-2237-TH1

Power Transformer

The LX Series power transformer is available in its complete, model-specific form. The socket housing and pins are included in the complete assembly, but are also available separately. Their connecting PCB header is listed with the A2 PCB common parts.

Designation	Description	Part #
Model LX 20-3	Transformer Assembly	T2-LXDL-20
Model LX 30-2	Transformer Assembly	T2-LXDL-30
Model LX 60-1	Transformer Assembly	T2-LXDL-60
Model LX 20-6	Transformer Assembly	T2-LXQ1-20
Model LX 30-4	Transformer Assembly	T2-LXQ1-30
Model LX 60-2	Transformer Assembly	T2-LXQ1-60
Model LXQ 20-3	Transformer Assembly	T2-LXQ1-20
Model LXQ 30-2	Transformer Assembly	T2-LXQ1-30
Model LXQ 60-1	Transformer Assembly	T2-LXQ1-60
	Socket Housing	MI-100S-CML
	Socket Pin	MC-6191-ML

Power Circuit (A2) Assembly

The parts list for the A2 Assembly is divided into:

1) Complete A2 Assembly with Heatsink (includes 2) and 3), below)
2) A2 PCB Common Parts
3) A2 PCB Differential Parts

1) Complete A2 Assembly with Heatsink

Designation	Description	Part #
Model LX 20-3	A2 PCB Assembly with Heatsink, dual units	X2-LXA2-203D
Model LX 30-2	A2 PCB Assembly with Heatsink, dual units	X2-LXA2-302D
Model LX 60-1	A2 PCB Assembly with Heatsink, dual units	X2-LXA2-601D
Model LX 20-6	A2 PCB Assembly with Heatsink, 120W primary	X2-LXA2-206P
	A2 PCB Assembly with Heatsink, 120W parallel	X2-LXA2-2061
Model LX 30-4	A2 PCB Assembly with Heatsink, 120W primary	X2-LXA2-304P
	A2 PCB Assembly with Heatsink, 120W parallel	X2-LXA2-3041
Model LX 60-2	A2 PCB Assembly with Heatsink, 120W primary	X2-LXA2-602P
	A2 PCB Assembly with Heatsink, 120W parallel	X2-LXA2-6021
Model LXQ 20-3	A2 PCB Assembly with Heatsink, master or slave	X2-LXA2-203D
Model LXQ 30-2	A2 PCB Assembly with Heatsink, master or slave	X2-LXA2-302D
Model LXQ 60-1	A2 PCB Assembly with Heatsink, master or slave	X2-LXA2-601D

2) A2 PCB Assembly Common Parts

Note that the 120W Dual models LX20-6, 30-4, and 60-2 are composed of A2 Primary and Parallel boards. The 60W Quad models LXQ20-3, 30-2, and 60-1 are composed of Master and Slave boards.

Circuit Designation	Description	Part #
C201,203,207*	10μF 63V 2.5mm Electrolytic Radial Capacitor	CL-100D-63
C202*	10000μF 25V 10mm Electrolytic Radial Capacitor	CL-103J-25
C204,205*	0.1μF 100V MF 10% 10mm Radial Capacitor	CD-104J-16
C206*	2200μF 16V 20% 16x25 7.5mm Elec Rad Cap	CL-222H-16
C208	0.1μF 100V MF 10% 10mm Radial Capacitor	CD-104J-16
C209,210*	100μF 25V 5mm Electrolytic Radial Capacitor	CL-101F-25
C211*	220μF 35V 5mm Electrolytic Radial Capacitor	CL-221F-35
C217	100μF 100V 5mm Electrolytic Radial Capacitor	CL-101F-76
CR201,202*	1N5402 Case 267-02 200V 3A Diode	CR-5402
CR203,204,205,206, 211,212,216	1N5402 Case 267-02 200V 3A Diode	CR-5402
CR207,208*	1N4005 R DO41 600V 1.A Diode	CR-4005
CR209*	200V 1A Bridge Rectifier 4-pin DIL	CR-B012
CR210,215*	1N825A VZ DO35 6.2V 400mW Zener Diode	CR-0825-A
F201	5A 250V 3AG Fast Fuse	F2-0500-F
For F201	Fuseclip, 3AG Tin-plate Brass PC Mount	MC-3001-FC
J201*	6.5"L 9-pin MTA Cable, 1 Female end	WA-0922-13
P201	10 pole Mate'n'Lok PCB Header	MC-100B-CML
Q201	TIP36C PB 100V 25A 125W TO218	QU-0036
For Q201,203	Transistor Clamp	SM-LXQC-A
Q202	TIP32C PB 100V 3A 40W TO220	QQ-0032-C
Q203	TIP35A NB 60V 25A 125W TO218	QT-0035-A
Q206*	2N5550 N 140V 0.2A 0.6W TO92 Transistor	QJ-5550
R201*	100Ω 1% 1/4W MF	R-1000-41
R202	12.1Ω 1% 1/4W MF	R-12R1-41
R203	5.1k 5% 2W Metal Film Capacitor	R-5101-2
R204	4.02k 1% 1/4W	R-4021-41
R208*	4.02k 1% 1/4W	R-4021-41
R209*	1.00kΩ 1% 1/4W MF	R-1001-41
R210*	10k 1% 1/4W	R-1002-41
R211	100Ω 1% 1/4W MF	R-1000-41
U201*	LT1085CT-5 3TR 5V 3A Low Dropout TO220	UR-1085-CT5
For U201*	Transistor Clamp	SM-LXQC-A
U202*	LM2940CT 3T 5V Low Sat Reg TO220	UR-2940-CT
For U202*	#6-32 x 1/4" KEP Nut	MN-632K-08
For U202*	#6-32 x 1/4" Philips Pan ZINC	MS-6P00-04
*** These Auxiliary Supply parts are common to all models except the Dual 120W Parallel A2 PCB (Models LX20-6 Parallel, LX30-4 Parallel, LX60-2 Parallel)**		

3) A2 PCB Assembly Differential Parts

These differential parts are divided into 20V, 30V, and 60V lists. On each list, certain circuits will require different parts, according to the actual supply model. Check your model number to confirm. Note that the 120W Dual models LX20-6, 30-4, and 60-2 are composed of A2 Primary and Parallel boards. The 60W Quad models LXQ20-3, 30-2, and 60-1 are composed of

Master and Slave boards. These boards will at times require different parts for equivalent circuit designations.

A2 PCB Assembly Differential Parts - 20V Models

Circuit Designation	Model Number	Description	Part #
	LX20-3 LXQ20-3 Slave LX20-6 Parallel	Heatsink	HS-LXAC
	LXQ20-3 Master LX20-6 Primary	Heatsink	HS-LX00
C212,216	LX20-3 LX20-6 LXQ20-3	47,000μF 16V 30Dx45L 10mm Snap-in Rad	CL-473J-16
C213	LX20-3 LX20-6 LXQ20-3	2.2nF 100V X7R 10% 5mm Cer Rad Cap	CB-222F-16
C214	LX20-3 LXQ20-3	Empty Position	C-EMPT
C214	LX20-6	4.7nF 100V X7R 10% 5mm Cer Rad Cap	CB-472F-16
C215	LX20-3 LXQ20-3	4.7nF 100V X7R 10% 5mm Cer Rad Cap	CB-472F-16
C215	LX20-6 Primary	10nF 100V X7R 10% 5mm Cer Rad Cap	CB-103F-16
C215	LX20-6 Parallel	Empty Position	C-EMPT
CR213,214	LX20-3 LX20-6 Parallel LXQ20-3	Empty Position	CR-EMPT
CR213,214	LX20-6 Primary	1N4148 UR D035 75V 300mA Diode	CR-4148
J201	LX20-3 LX20-6 Primary LXQ20-3	6.5"L 9-pin MTA Cable, 1 Female end	WA-0922-13
J201	LX20-6 Parallel	8.5"L 9-pin MTA Cable, 1 Female end	WA-0922-17
Q204,205	LX20-3 LX20-6 Parallel LXQ20-3	Empty Position	Q-EMPT
Q204	LX20-6	TIP 31C NB 100V 3A 40W TO220	QP-0031-C
Q205	LX20-6 Primary	MPS-A92 PB 300V 500mA 625mW	QN-MPSA-92
R204	LX20-3 LXQ20-3	4.02k 1% 1/4W	R-4021-41

Continued on next page.

A2 PCB Assembly Differential Parts - 20V Models (continued)

Circuit Designation	Model Number	Description	Part #
R204,206, 207	LX20-6	187Ω 1% 1/4W MF	R-1870-41
R205	LX20-6 Primary	2k 1% 1/4W MF	R-2001-41
R205,206, 207	LX20-6 Parallel	Empty Position	R-EMPT
R205,206, 207, 213	LX20-3 LXQ20-3	Empty Position	R-EMPT
R212	LX20-3 LXQ20-3	#24 Bus Wire Tinned/Jumper	WB-0024-0010
R212	LX20-6	0.1Ω 5% 2W MF	RA-R100-2
R213	LX20-6 Primary	Empty Position	R-EMPT
R213	LX20-6 Parallel	1Ω 1% 1/4W MF	R-1R00-41
R214	LX20-3 LXQ20-3	1k 5% 2W	R-1001-2
R214	LX20-6 Primary	1k 5% 2W	R-1001-2
R214	LX20-6 Parallel	Empty Position	R-EMPT
WJ201	LX20-3 LXQ20-3	#24 Bus Wire Tinned/Jumper	WB-0024-0010
WJ201	LX20-6	Empty Position	R-EMPT

A2 PCB Assembly Differential Parts - 30V Models

Circuit Designation	Model Number	Description	Part #
	LX30-2 LXQ30-2 Slave LX30-4 Parallel	Heatsink	HS-LXAC
	LXQ30-2 Master LX30-4 Primary	Heatsink	HS-LX00
C212,216	LX30-2 LX30-4 LXQ30-2	22,000μF 25V 30D x 45L 10mm Snap-in Rad	CL-223J-25
C213	LX30-2 LXQ30-2	2.2nF 100V X7R 10% 5mm Cer Rad Cap	CB-222F-16
C213	LX30-4	4.7nF 100V X7R 10% 5mm Cer Rad Cap	CB-472F-16
C214	LX30-2 LXQ30-2	Empty Position	C-EMPT
C214	LX30-4 Primary	2.2nF 100V X7R 10% 5mm Cer Rad Cap	CB-222F-16

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A2 PCB Assembly Differential Parts - 30V Models (continued)

Circuit Designation	Model Number	Description	Part #
C214	LX30-4 Parallel	6.8nF 50V X7R 10% 5mm Cer Rad Cap	CB-682F-06
C215	LX30-2 LXQ30-2	4.7nF 100V X7R 10% 5mm Cer Rad Cap	CB-472F-16
C215	LX30-4	10nF 100V X7R 10% 5mm Cer Rad	CB-103F-16
CR213,214	LX30-2 LX30-4 Parallel LXQ30-2	Empty Position	CR-EMPT
CR213,214	LX30-4 Primary	1N4148 UR D035 75V 300mA Diode	CR-4148
J201	LX30-4 Parallel	8.5"L 9-pin MTA Cable, 1 Female end	WA-0922-17
Q204,205	LX30-2 LXQ30-2	Empty Position	Q-EMPT
Q204	LX30-4	TIP 31C NB 100V 3A 40W TO220	QP-0031-C
Q205	LX30-4 Primary	MPS-A92 PB 300V 500mA 625mW	QN-MPSA-92
Q205	LX30-4 Parallel	Empty Position	Q-EMPT
R204	LX30-2 LXQ30-2	4.02k 1% 1/4W	R-4021-41
R204	LX30-4 Parallel	187Ω 1% 1/4W MF	R-1870-41
R204,206, 207	LX30-4 Primary	187Ω 1% 1/4W MF	R-1870-41
R205	LX30-4 Primary	2k 1% 1/4W MF	R-2001-41
R205,206, 207	LX30-4 Parallel	Empty Position	R-EMPT
R205,206, 207,213	LX30-2 LXQ30-2	Empty Position	R-EMPT
R212	LX30-4	0.1Ω 5% 2W MF	RA-R100-2
R212	LX30-2 LXQ30-2	#24 Bus Wire Tinned/Jumper	WB-0024-0010
R214	LX30-2 LXQ30-2	1k 5% 2W	R-1001-2
R214	LX30-4 Primary	5.1k 5% 2W MF	R-5101-2
R214	LX30-4 Parallel	Empty Position	R-EMPT
WJ201	LX30-2 LXQ30-2	#24 Bus Wire Tinned/Jumper	WB-0024-0010
WJ201	LX30-4	Empty Position	R-EMPT

A2 PCB Assembly Differential Parts - 60V Models

Circuit Designation	Model Number	Description	Part #
	LX60-1 LXQ60-1 Slave LX60-2 Parallel	Heatsink	HS-LXAC
	LXQ60-1 Master LX60-2 Primary	Heatsink	HS-LX00
C212,216	LX60-1 LX60-2 LXQ60-1	10,000µF 250V 30Dx50L 10mm Snap-in Rad	CL-103J-50
C213	LX60-1 LXQ60-1	2.2nF 100V X7R 10% 5mm Cer Rad Cap	CB-222F-16
C213	LX60-2	4.7nF 100V X7R 10% 5mm Cer Rad Cap	CB-472F-16
C214	LX60-1 LXQ60-1	Empty Position	C-EMPT
C214	LX60-2	2.2nF 100V X7R 10% 5mm Cer Rad Cap	CB-222F-16
C215	LX60-1 LX60-2 Primary LXQ60-1	4.7nF 100V X7R 10% 5mm Cer Rad Cap	CB-472F-16
C215	LX60-2 Parallel	Empty Position	C-EMPT
CR213,214	LX60-1 LX60-2 Parallel LXQ60-1	Empty Position	CR-EMPT
CR213,214	LX30-4 Primary	1N4148 UR D035 75V 300mA Diode	CR-4148
J201	LX60-2 Parallel	8.5"L 9-pin MTA Cable, 1 Female end	WA-0922-17
Q204,205	LX60-1 LXQ60-1	Empty Position	Q-EMPT
Q204	LX60-2	TIP 31C NB 100V 3A 40W TO220	QP-0031-C
Q205	LX60-2 Primary	MPS-A92 PB 300V 500mA 625mW	QN-MPSA-92
Q205	LX60-2 Parallel	Empty Position	Q-EMPT
R204	LX60-1 LXQ60-1	4.02k 1% 1/4W	R-4021-41
R204	LX60-2 Parallel	187Ω 1% 1/4W MF	R-1870-41
R204,206,207	LX60-2 Primary	187Ω 1% 1/4W MF	R-1870-41
R205	LX60-2 Primary	2k 1% 1/4W MF	R-2001-41

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A2 PCB Assembly Differential Parts - 60V Models (continued)

Circuit Designation	Model Number	Description	Part #
R205,206,207	LX60-2 Parallel	Empty Position	R-EMPT
R205,206, 207,213	LX60-1 LXQ60-1	Empty Position	R-EMPT
R212	LX60-2	0.1Ω 5% 2W MF	RA-R100-2
R212	LX60-1 LXQ60-1	#24 Bus Wire Tinned/Jumper	WB-0024-0010
R214	LX60-1 LX60-2 Primary LXQ60-1	5.1k 5% 2W MF	R-5101-2
R214	LX60-2 Parallel	Empty Position	R-EMPT
WJ201	LX60-1 LXQ60-1	#24 Bus Wire Tinned/Jumper	WB-0024-0010
WJ201	LX60-2	Empty Position	R-EMPT

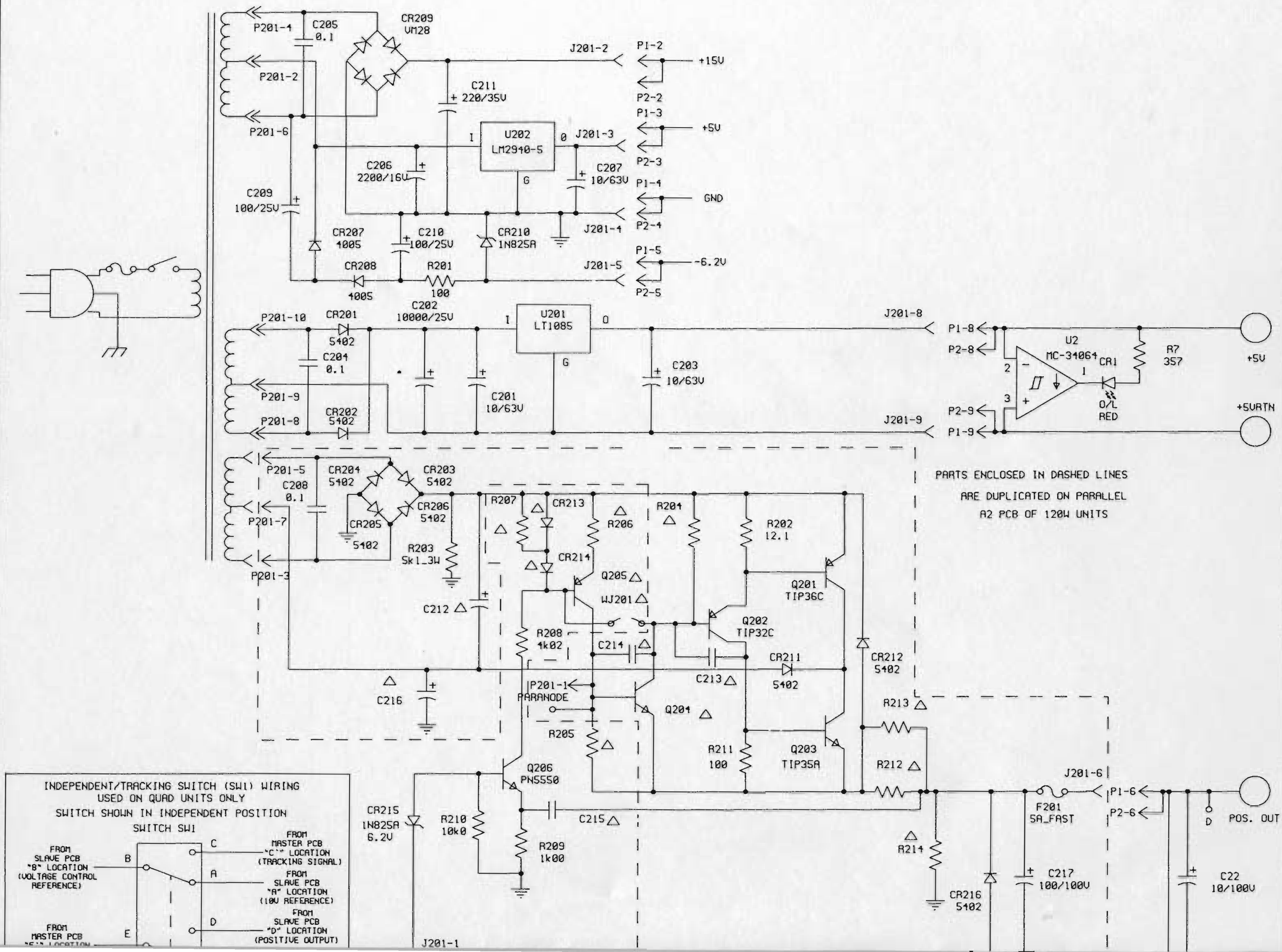
AC Input and Miscellaneous Parts

AC Input

Designation	Description	Part #
	SJT 6' 18-3 Power Cord (LX)	WP-SJT8
	Strain Relief For SJT,S,&ST 0.875"dia	MI-1240-SR
	Fuseblock,3AG Tin-plate Brass Spade Lug	MC-3000-FB
	SPST 5A/125Vac Rocker, Unmarked, 0.187 F.O.	SW-1126-RG1

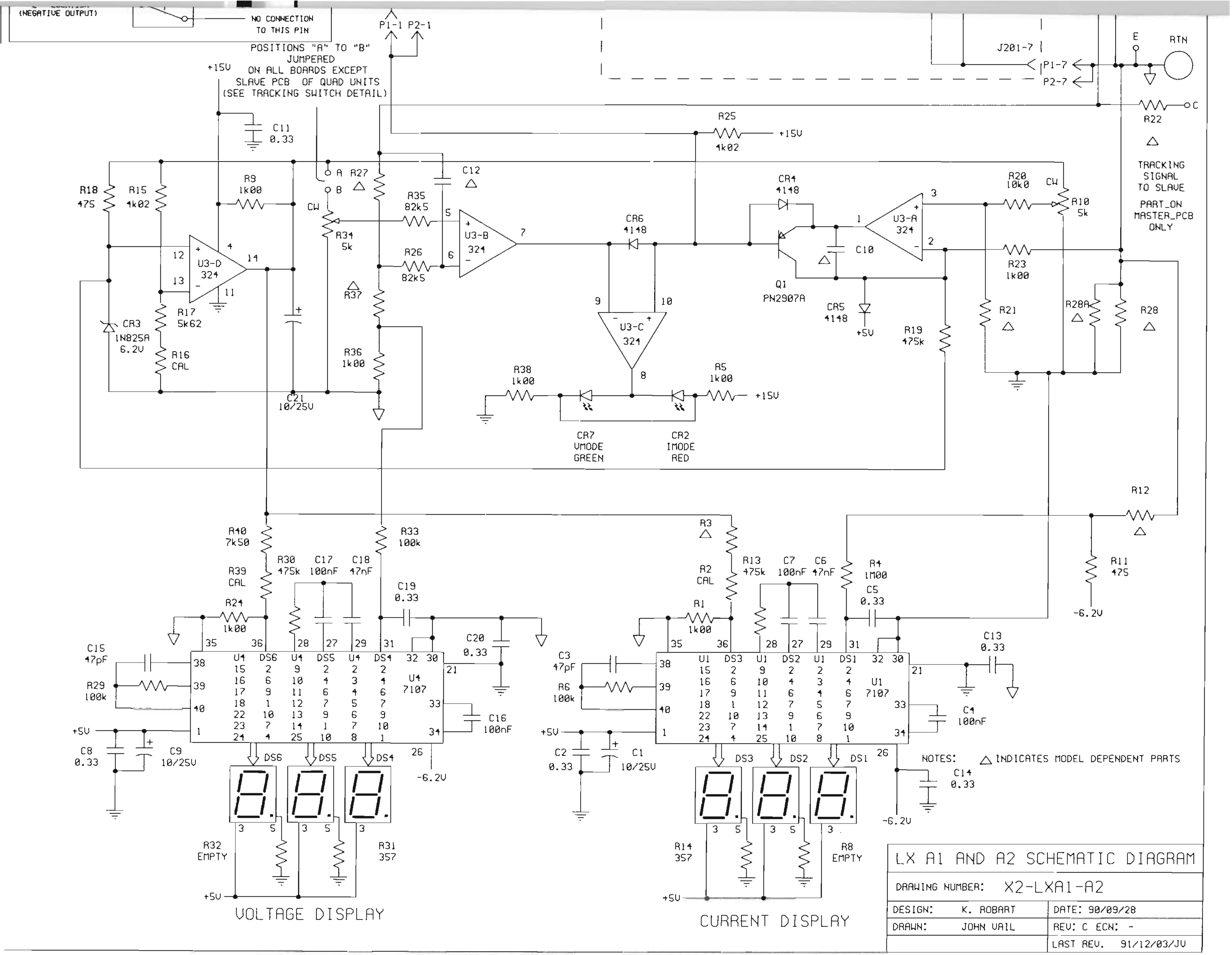
Miscellaneous Parts

Designation	Description	Part #
	5A Slow 250V 3AG	F2-0500-S
	5A Fuse Warning Label	LA-F5A0-EF
	Dual Base, Blk 4.25" x 9.5" x 0.5"	SM-LXBS-D
	Quad/120W Base, Blk 8.5" x 9.5" x 0.5"	SM-LXBS-Q1
	Dual Cover, Blk 4.25" x 9.5" x 4.5"	SM-LXCR-D
	Quad/120W Cover, Blk 8.5" x 9.5" x 4.5"	SM-LXCR-Q1
For cover & base	#6-32 x 3/16" Philips Truss	MS-6P29-03
For cover & base	#6-32 x 5/16" Philips Truss Type A	MS-6P36-05
	#8-32 x 5/16" KEP Nut	MN-832K-10
	#8 x 7/16" Plated Flatwasher, 0.042"	MW-8414-42
	#6-32 x 5/16" Philips Pan Zinc Screw	MS-6P00-05
	#6-32 x 1/4" KEP Nut	MN-632K-08
	1/2"SQ x 0.23"H Adhesive-Backed Vinyl Foot	MF-SB08-04V



INDEPENDENT/TRACKING SWITCH (SW1) WIRING
USED ON QUAD UNITS ONLY
SWITCH SHOWN IN INDEPENDENT POSITION

PARTS ENCLOSED IN DASHED LINES
ARE DUPLICATED ON PARALLEL
A2 PCB OF 120W UNITS



NOTES: △ INDICATES MODEL DEPENDENT PARTS

LX A1 AND A2 SCHEMATIC DIAGRAM			
DRAWING NUMBER:	X2-LXA1-A2		
DESIGN:	K. ROBART	DATE: 90/09/28	
DRAWN:	JOHN VAIL	REV: C ECN: -	
		LAST REV.	91/12/03/JV